I claim:

1. An electrowinning cell adapted to recover metal ions from a solution as their corresponding elementary metals, comprising:

(a) a reservoir adapted to receive a solution containing metal ions at a selected concentration;

(b) an anode and a cathode disposed in said reservoir, said anode and cathode operative to establish an electric potential difference therebetween;

(c) a filter in fluid communication with said reservoir and operative to receive the solution from a location proximate to said cathode, wherein said filter is operative to retain a first portion of the solution having a first concentration of metal ions and to remove a second portion of the solution having a second concentration of metal ions lower than the first concentration; and

(d) return means operative to return the first portion of the solution to said reservoir.

2. An electrowinning cell according to claim 1 including an agitator in fluid communication with said reservoir.

3. An electrowinning cell according to claim 2 wherein said agitator is disposed in said reservoir.

4. An electrowinning cell according to claim 2 wherein said agitator includes a fluidized bed of glass beads.

5. An electrowinning cell according to claim 2 wherein said agitator includes a motor which engages said cathode and is operative to rotate said cathode about a longitudinal axis thereof.

6. An electrowinning cell according to claim 1 including a power source in electrical communication with said anode and cathode and operative to supply a voltage differential to said anode and cathode.

7. An electrowinning cell according to claim 1 wherein said filter is a nanofilter.

8. An electrowinning cell according to claim 1 wherein said filter is a crossflow membrane filter.

9. An electrowinning cell according to claim 1 wherein the second concentration of metal ions is about zero.

10. An electrowinning cell according to claim 1 including a solution holding tank in fluid communication with said reservoir and said filter.

11. An electrowinning cell according to claim 10 including a filter collection tank in fluid communication with said solution holding tank and said filter.

12. An electrowinning cell according to claim 11 including a valve fluidly disposed between said solution holding tank and said filter collection tank and including a concentration sensor disposed in said solution holding tank and a controller in communication with said valve and said sensor, whereby said sensor and said controller are operative to monitor a concentration of metal ions in said solution holding tank and to move said valve between a first state allowing fluid flow to said filter collection tank when the concentration of metal ions is no greater than a selected concentration and to move said valve into a second

state preventing fluid flow to said filter collection tank when the concentration of metal ions is greater than the selected concentration.

13. An electrowinning cell according to claim 11 wherein said filter is a nanofilter and including a microfilter fluidly disposed between said filter and said filter collection tank.

14. An electrowinning cell according to claim 10 including an electrowinning collection tank in fluid communication with said solution holding tank and said reservoir.

15. An electrowinning cell according to claim 1 wherein said return means includes a conduit in fluid communication with said reservoir.

16. An electrowinning cell according to claim 1 including a flow-rate sensor and a valve in fluid communication with the solution, said valve having a first state allowing fluid flow and a second state preventing fluid flow, and including a microprocessor control operative to receive data from said flow-rate sensor and to adjust a flow-rate of the solution by moving said valve between the first and second states.

17. A method of concentrating metal ions in a solution for use in an electrochemical cell, comprising the steps of:

(a) drawing a portion of a solution containing metal ions from a region proximate to a cathode in an electrochemical cell;

(b) filtering the portion of the solution thereby to create a retentate having a first concentration of metal ions and a permeate having a second concentration of metal ions lower than the first concentration; and

(c) returning said retentate to said electrochemical cell.

18. A method according to claim 17 wherein said electrochemical cell is an electrolytic cell.

19. A method according to claim 17 including the step of continuously providing the solution containing metal ions to the electrochemical cell from a fluid source and the step of continuously removing the permeate.

20. A method according to claim 17 wherein the step of filtering is accomplished with a nanofilter operative to retain said metal ions.

21. A method according to claim 17 wherein the solution is agitated in the region proximate to said cathode.

22. A method according to claim 17 wherein said metal ions are divalent copper ions.

23. A system for reducing metal ions in a solution to their corresponding elementary metals, comprising:

(a) a fluid source operative to provide a solution containing metal ions at a selected concentration;

(b) a reservoir in fluid communication with said fluid source and operative to receive the solution;

(c) an anode disposed in said reservoir;

(d) a cathode disposed in said reservoir;

(e) a power source operative to supply electric current to said anode and said cathode;

(f) a filter in fluid communication with said reservoir and including a membrane, said filter having a first region on one side of said membrane and a second region on an opposite side of said membrane;

(g) a retentate of the solution disposed in the first region of the filter, said retentate having a first concentration of metal ions;

(h) a permeate of the solution disposed in the second region of the filter, said permeate having a second concentration of metal ions lower than the first concentration; and

(i) a return means operative to return said retentate to said reservoir.

24. A system according to claim 23 wherein the solution is constantly drawn from a region proximate said cathode and provided to said filter.

25. A system according to claim 24 wherein said fluid source constantly provides the solution.

26. A system according to claim 23 wherein said filter is a crossflow membrane filter.

27. A system according to claim 23 wherein said membrane is a nanofilter membrane.

28. A system according to claim 23 including a pump in fluid communication with said filter and operative to provide the solution to said filter at a selected fluid pressure.

29. A system according to claim 23 wherein said retentate includes a first portion of the solution which does not pass through said membrane and wherein said permeate is formed by passing a second portion of the solution through said membrane.

30. A system according to claim 23 wherein gravity is operative to return said retentate to said reservoir.

31. In an electrowinning cell operative to reduce metal ions at a selected concentration in a solution at a location proximate to a cathode in a reservoir to their corresponding elementary metals, the improvement comprising a filter apparatus in fluid communication with said reservoir and operative to draw the solution from a region proximate to said cathode and to filter the solution into a first portion having a first concentration of metal ions greater than the selected concentration and a second portion having a second concentration of metal ions lower than the selected concentration, said filter apparatus further operative to return the first portion to said reservoir.

32. The improvement according to claim 31 wherein said filter apparatus includes a filter, a valve, a conduit and a pump.

33. The improvement according to claim 32 wherein said filter includes a membrane filter of the nanofiltration range.

34. An electrowinning cell adapted to recover metal ions from a solution as their corresponding elementary metals, comprising:

(a) a reservoir adapted to receive a solution containing metal ions at a selected concentration;

(b) an anode and a cathode disposed in said reservoir, said

anode and cathode operative to establish an electric potential difference therebetween;

(c) a first conduit in fluid communication with said reservoir and having an inlet and an outlet, wherein said inlet of said first conduit is proximate to said cathode and is operative to receive the solution;

(d) a filter in fluid communication with said outlet of said first conduit and operative to receive the solution therefrom, wherein said filter is operative to retain a first portion of the solution having a first concentration of metal ions and to remove a second portion of the solution having a second concentration of metal ions lower than the first concentration; and

(e) a second conduit in fluid communication with said filter and said reservoir, said second conduit including an inlet operative to receive said first portion of the solution from said filter and an outlet operative to return said first portion of the solution to said reservoir.

35. An electrowinning cell adapted to recover metal ions from a solution as their corresponding elementary metals, comprising:

(a) a solution holding tank adapted to receive a solution containing metal ions at a selected concentration from a fluid source;

(b) an electrowinning collection tank adapted to receive the solution;

(c) a first circulating conduit loop in fluid communication with said solution holding tank and said electrowinning collection tank and adapted to circulate the solution between said solution holding tank and said electrowinning collection tank;

(d) an electrowinning reservoir adapted to receive the solution;

(e) an anode and a cathode disposed in said electrowinning reservoir, said anode and cathode operative to establish an electric potential difference therebetween;

(f) a second circulating conduit loop in fluid communication with said solution holding tank and said electrowinning reservoir and adapted to circulate the solution between said solution holding tank and said electrowinning reservoir;

(g) a filter collection tank adapted to receive the solution;

(h) a third circulating conduit loop in fluid communication with said solution holding tank and said filter collection tank and adapted to circulate the solution between said solution holding tank and said filter collection tank;

(i) a nanofilter adapted to receive the solution and operative to concentrate metal ions in the solution thereby to form a retentate and a permeate, said retentate having a greater concentration of metal ions than said permeate; and

(j) a fourth circulating conduit loop in fluid communication with said filter collection tank and said nanofilter and adapted to provide the solution from said filter collection tank to said nanofilter and to return said retentate from said nanofilter to said filter collection tank.